NOV. 8 '02

THE NEW YORK PUBLIC LIBRARY

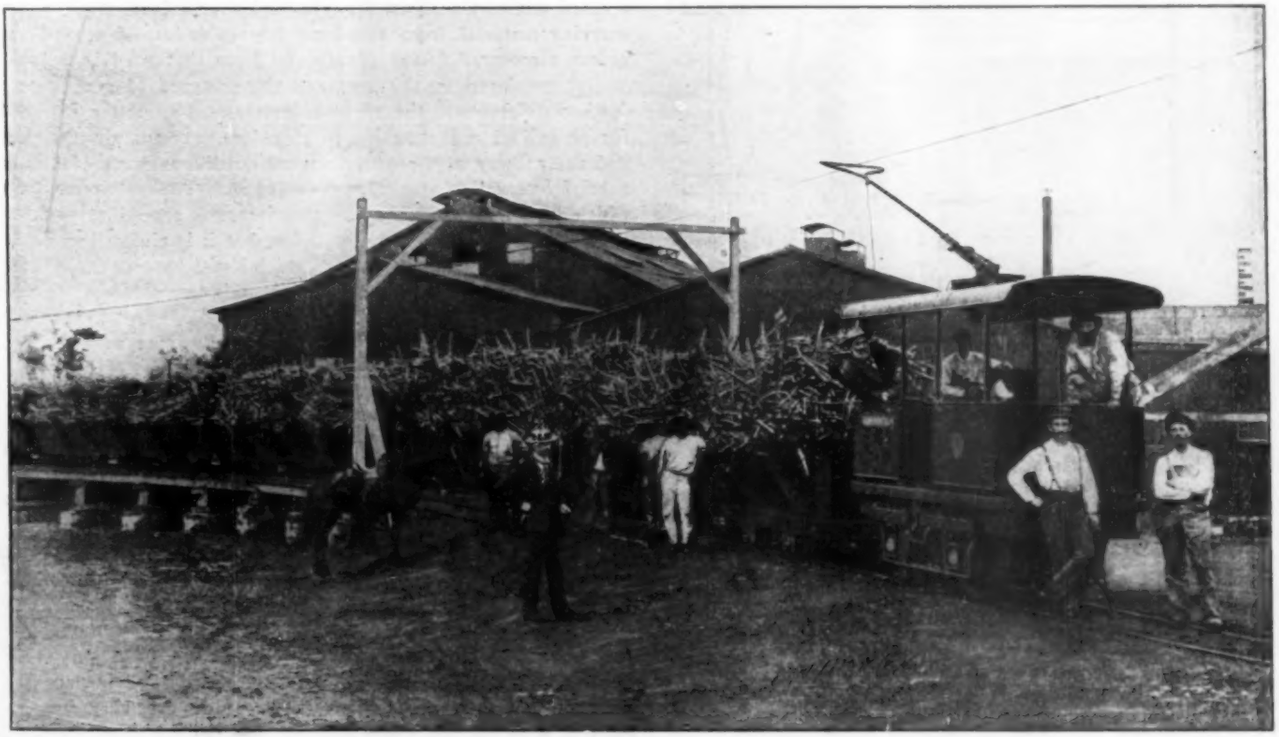
POPULAR MECHANICS

An Illustrated Weekly Review of the Mechanical Press of the World

"Tells you how to do things." Written so you can understand it.

Vol. 2. No. 19. CHICAGO, NOVEMBER 8. 1902. PRICE 5 CENTS.

The Electric Locomotive in Hawaii



Hauling Sugar Cane by Electricity in Our New Possessions

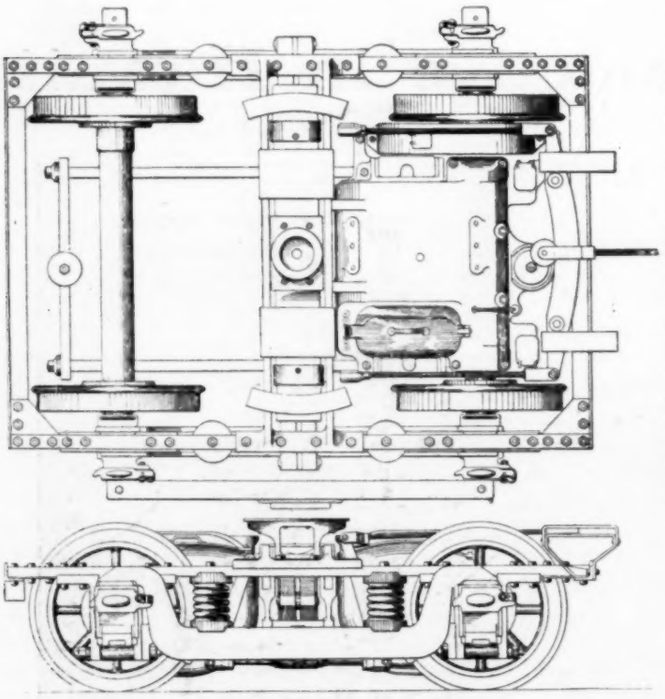
IN THIS ISSUE:

Electric Locomotives in Hawaii
Garretson Smelting Furnace a Wonder.
Baby Phones News of Its Birth.
Cars that Run Without Attendants.
To Find Your Way When Lost in a Forest.
Women Skin Their Faces to Become Beautiful.
Alarm Clock that Starts the Fire.
Lost Aztec Silver Mine Found.
Claims a Substitute for Steam.
First Picture of Globular Lightning.
College to Educate Monkeys.
Higher Cost of Building.
Where Texas' Heroes Fell.
Developing Photographs Without a Dark Room.
Simple Experiment Illustrates Expansion of Iron.
A Talking Newspaper.
The Boomerang as a Life Saver.
Device for Landing Big Fish.
Americans Great Inventors.
Home Made Apparatus for Copying Drawings.
Female Fire Fighters in New York.
Why the Barrel is Strong.
Galveston Rises from Its Ruins.
Municipal Ownership in Glasgow.
Shop Notes:—Painting the Smokestack—New Band Saw Brazing Apparatus—To Clean Clogged Water Pipes in Gasoline Autos—Repairing the Broken Thread End of an Axle—Consumption of Iron in the United States.

ELECTRIC LOCOMOTIVES IN HAWAII.

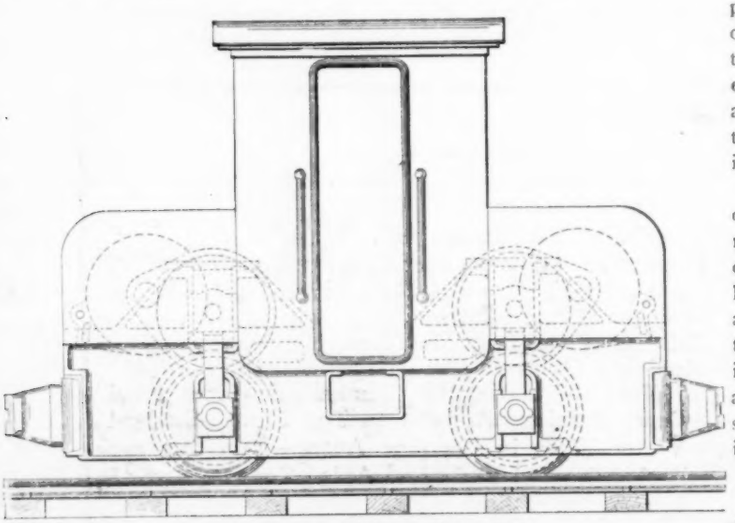
Our New Island Taking the Lead in Use of Electricity for Heavy Traffic.

Since entering the large family of Uncle Sam Hawaii has commenced to display enterprise that is somewhat surprising to her former insular associates. Hawaii is one of the first countries to adopt electricity for heavy traffic. The front page illustration shows an electric locomotive pulling a heavy train of sugar cane on one of the extensive sugar plantations



Plan of Electric Locomotive Truck.

of that country. The locomotive was built by the Westinghouse Manufacturing Co., of Pittsburg, Pa., for the Hawaiian Electric Co. The sugar cane is being hauled from the plantation to the grinder. The locomotive is of the open canopy type and weighs 19,000 pounds. It is only one of the locomotives, told of in the last issue of Popular Mechanics, which have recently been built for heavy traffic and shipped to all parts of the world, several being in use in Hawaii. They are the handwriting on the wall that presages the ultimate end of the steam engine for pulling passenger and freight trains. It is the transmission of electricity at high potential for long distances that has opened the wider field for electric locomotives in heavy railroad service.



Mounting Large Motor on Narrow Gage.

This type of electric locomotive has additional interest from the fact that it is narrow gage. The line was formerly operated with steam and the new motor cars had to conform to the track. To place the motors under the car, suspended from the car axle, as is the general custom, would not have afforded sufficient space to contain motors of as large power as required. Hence the motors are placed in the cab and transmit to the car axles by intermediate gearing; the motors being hung on the shafts of the intermediate gear. The Street Railway Journal says: The experience of the engineers, as well as the companies that have employed electric locomotives, is that one of the most important questions to be determined is the proper capacity of the motors to be employed. Locomotives of the same draw-bar pull may require very different motors. It is pointed out that a short, straight haul over a level track, as in carrying material from a railway line to industrial works, requires a motor differing in capacity from that used in a locomotive employed in shifting; and the presence of grades may further differentiate the types of motors. The power required for propelling a locomotive is, therefore, exceedingly variable, and the railway motor under normal conditions works for only a brief interval at any one given output. The maximum load which it can momentarily carry under such conditions will, of course, depend upon its commutation, but it is almost invariably the temperature rise of the coils which limits its capacity. With rapidly intermittent and varying loads, this temperature rise will not follow each application or change of the current, but will depend upon the average rate of working of the motor.

GARRETSON SMELTING FURNACE A WONDER.

May Mark a New Era in the Treatment of Sulphide Ores.

The Garretson pyritic converting furnace promises to work as great a revolution in the treatment of low grade sulphide ores as did the Bessemer converter in the production of steel. In a recent test at Victoria, B. C., the furnace proved that it could smelt wet ore direct from the mine without previous roasting or crushing and with the least possible consumption of fuel, that it could reduce the low grade ore to a very rich matte and convert the matte into pig copper. The furnace reduced to matte, without fluxes, low grade ore very heavily charged with barytes.

By the old methods the ordinary process of handling sulphide ore embraced three stages—first, roasting or calcining the ore, which entails considerable cost and waste; second, smelting the roasted ore in blast or reverberatory furnaces (in this operation the fuel used in smelting the charge forms, on an average, about 60 per cent of the cost of the blast furnace process); third, converting or bessemerizing the matte produced in smelting to metallic copper.

The Garretson furnace combines these three operations in the one furnace. The furnace is adapted to receive the raw unroasted sulphide ore just as it comes from the mine and in one operation reduce it to metallic copper, at the same time collecting and saving whatever precious metals may be present, and this without the use of any coal, coke or other fuel, except that which the ore itself contains in the form of sulphur and iron. The slag which is discharged from the furnace carries away less than 1-20th part as much copper as is lost in the slag by the ordinary process, thus effecting an additional saving of great importance.

"Popular Mechanics interests everybody interested in mechanics."—The Atlantic (Iowa) Telegraph.

BABY PHONES NEWS OF ITS BIRTH.

Ten Minutes Old Chicago Infant Announces Its Arrival to New York Grandparents.

Strange things happen in this age of science, but the limit seems to have been reached when the Chicago baby, just ten minutes old, telephoned to its grandparents in New York the news of its arrival and good health. When the telephone bell rang in the home of the New York man, half awake and dimly conscious that it was long past midnight, he staggered to the phone.

"Hello!" he said.

Over the wire came the plaintive wail of a new-born baby.

"Hurrah!" he cried. "It's Jack's long-distance telephone. The baby has come! Say, mother, mother, get up quick! You are a grandmother!"

"How do you know?" cried a woman's voice, excitedly.

"Why, the baby himself is telephoning from Chicago!"

"Well, father," said another voice through the telephone, "what do you think of your first grandson? Just ten minutes old, and announcing his arrival to his New York grandparents! He is lying on a pillow, and whenever he screams I put the 'phone to his mouth."

"People who talk of the 'good old times' should read some facts that have been compiled by Popular Mechanics."—The Washington Times.

CARS THAT RUN WITHOUT ATTENDANTS.

Unique Elevated Cable Railways That Are Novelties to Persons Not Accustomed to Them.

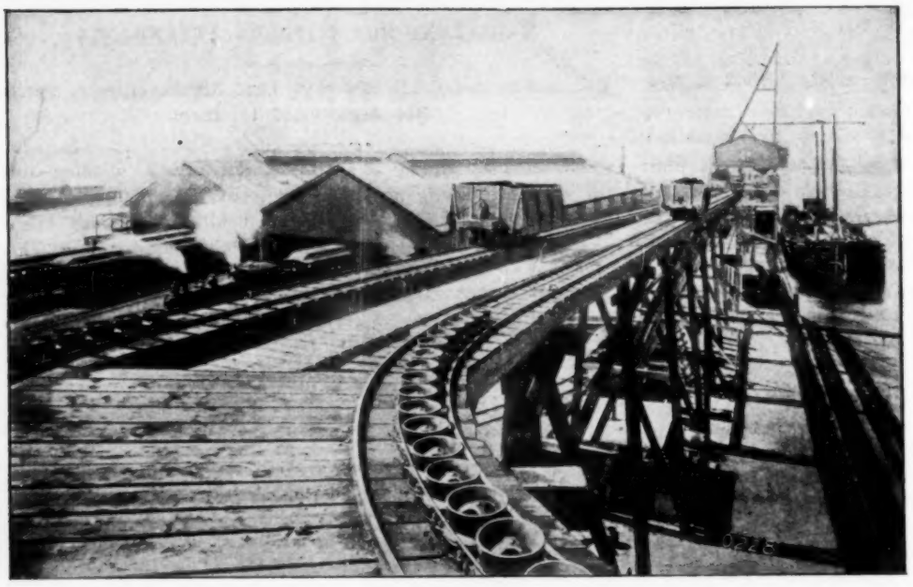
To see cars gliding along an elevated track, winding about the curves, climbing up and down inclines, dumping their loads and returning to the starting point all without any one in charge is a strange sight to persons not familiar with it. These

General View of the Cable Railway at Somerville, Mass. Built by C. W. Hunt Co., for J. Rougan, Boston & Maine Ry.

cars are used at mines, coal docks, various kinds of manufacturing plants, etc. They are propelled by cables and the railway is so arranged that the track forms a continuous line, enabling the car to pass over the whole track and back to the starting point, automatically dumping its load at any point desired. The cable runs continuously, supported on the straight line by idle pulleys and on the curved parts by special horizontal pulleys.

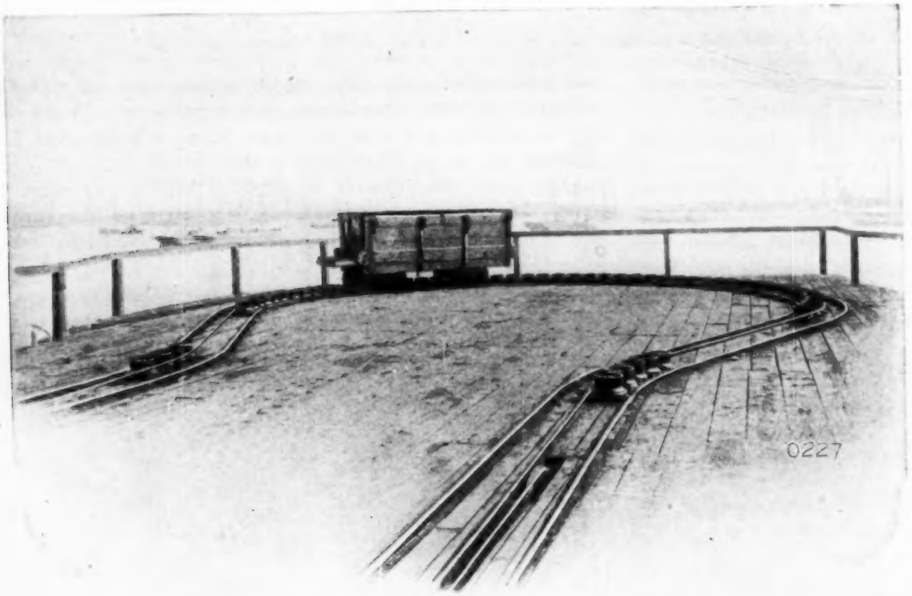
The cars used at coal mines usually carry about two tons of coal each, and when loaded at the wharf are gripped to the

Hunt Cable Railway at the Copenhagen Gas Works, Copenhagen, Denmark.



Showing method of carrying the rope around the curves on a continuous service of pulleys that prevent short bends in the cable that are so injurious to its life. It is equivalent to running this cable over a pulley 24 feet in diameter.

cable and instantly they start on their course, going slowly so as to make it safe for them to make the trip around the tracks without attendants. When a car returns to the wharf a workman steps on board, unfastens the cable grip and runs the car under the loading hopper, where it is loaded and again sent over the tracks. The rope moves at any desired speed, taking cars with it either up inclines or around curves, as the situation may demand. As many cars as desired may be run on the track, the number being determined by the length of the track and the number of tons to be handled per day. The Hunt Cable Railway Co. has recently made many important improvements in the methods of installing these cable systems which has added greatly to their efficiency. For driving the cable the Hunt Co. has built a special steam engine with two cylinders of such power as the length of the railway, the number of cars in use and the grade of the tracks, make necessary.



Hunt Cable Railway installed for C. W. Claflin Co., Boston, Mass.

WHEN YOU GET LOST.

Mr. George Kennan, who has perhaps traveled over more trackless wastes than any other living man, has contributed a valuable article for the advice of those who may lose their way in a forest.

When you discover that you have lost your way sit down instantly. You have probably strayed only a short distance from trail, he says in the Outlook, because otherwise the branches of the undergrowth would sooner have attracted your attention by striking your face or shoulders. Then with all your strength of mind remind yourself that if you allow yourself to become panic-stricken and rush off aimlessly, you will only get deeper and deeper into the woods. In the thousand-square-mile forest tracts of Michigan or the Adirondacks or Maine you might never be heard of again.

The first act is to break the top of a bush and bend it over. The under side of the leaves shows such different tints from the upper as to be quickly noticeable. To this first bush tie your handkerchief for a base. Walk slowly away, breaking and bending over bush ops every ten or twelve feet for a trial, and never lose sight of your handkerchief. After a while return to your base and try another direction, always leaving a trail of bent bushes behind you. Shout whenever you return to your base.

In this manner one can usually find his way to the beaten path in a few minutes, or be found by search-parties. Even children can and should be taught this simple lesson before they are allowed near large tracts of forest.

Persons going deliberately into the woods to fish or hunt should always wear a small compass suspended by a chain about the neck. In a pocket it is subject to too many chances of loss. If to the compass be added a tiny chamois bag containing a tighly corked bottle of matches, twenty feet of silk cord, a fish hook and a few tablets of compressed food, the tourist's life is practically safe even though he be lost for days.

Mr. Edison has often said that he never knew and never cared to know what the time was. He only believes in letting not a minute slip by, as that minute might yield an important invention. A friend of his once called on the inventor and presented his boy, asking for a word of advice and a motto the youth might adopt in his work. Edison was very busy with half a dozen engagements pressing. It was near the noon hour and the boy was noticed to frequently glance at the clock. Edison turned to him, grasped his hand and said: "Young man, the best advice I can give you is, never look at the clock."

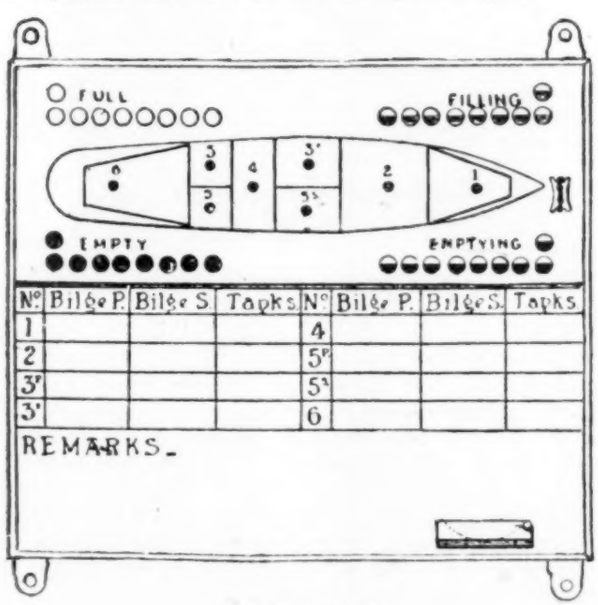
SKIN FACE TO BECOME BEAUTIFUL.

Barbarous Electrical Treatment Resorted to by Society Women.

Skinning the face by means of electricity is a new method some society women have adopted or making themselves look beautiful. The woman provides herself with an electric battery and to a wire leading from this she attaches a sponge. The sponge is dipped in a solution which irritates the flesh and rubbed back and forth over the face until the skin is highly sore and almost ready to peel. Then the entire face is covered with plasters. The patient wears the plasters three days or until suppuration begins. During this time she suffers every known torture for the skin must actually drop off. When the plasters are removed the skin comes with them and the face is left perfectly raw. Recovering from its red and raw state the skin becomes perfectly white. It is really a new skin she has produced. The woman now rejoices in a skin as pure and beautiful as it was the day she was a debutante. But it does not last. The skin lacks the foundation of flesh behind it. It is tender, and so wrinkles, freckles, catches the dust, grows rough and takes on blemish much worse than ever before.

SHIP BALLAST TANK INDICATOR.

To give visible indication of the condition of the ballast tanks on board ship, J. L. Clark has invented the form of indicator illustrated herewith, says Shipping World, London. In this the condition of the respective tanks is shown in a plan upon a board by means of black, white and mixed plugs which are inserted into holes numbered to correspond with the different tanks. The plugs are locked in place by a slotted sliding plate mounted in grooves behind the board. The lower part of the board presents numbered spaces, and a general space, for remarks. The appliance possesses the merit of extreme simplicity, and its use should prevent the possibility of any accident occurring through unintentionally altering trim.



Ballast Tank Indicator.

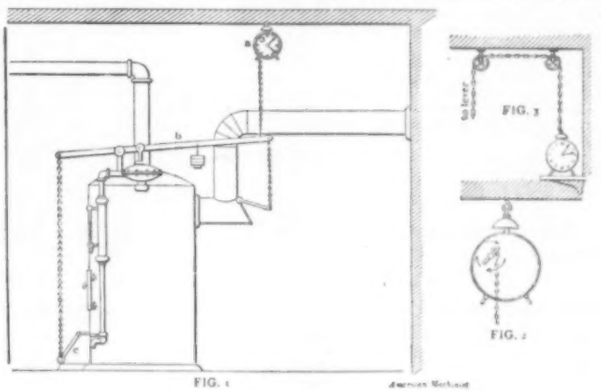
"Of course," said one old farmer to the other, "your boy is learnin' Latin and Greek at college, but is he gittin' anything practical?" "Oh, yes. In the last letter he writ he tells me he is takin' lessons in fencin'."

ALARM CLOCK THAT STARTS THE FIRE.

Simple Device Anyone Can Make.

SHIP BALLAST TANK INDICATOR.

There is no need of getting out of bed at 5 o'clock on a winter's morning to start the fire so the house will be warm when wind up an alarm clock and set it at the desired hour and the rest is easy. The mechanism of the new device can be arranged by anyone who has any mechanical ideas. The cut, from the American Machinist, tells its own story, and while illustrating the attachment as made to a steam heater applies equally to a hot air furnace. Connect one end of a lever to the front damper, and the other end to the damper in the pipe, and weight it until an easy balance is secured. Then proceed as follows: A 75-cent alarm clock is hung on a hook directly above the weighted end of the lever, a light chain is attached to this end of the lever, and, having a ring at the other end, is carried upward and the ring slipped over the key of the alarm, as shown in Fig. 2. The length of the chain is so adjusted that when the ring is attached to the alarm key the weighted end of the lever b is raised sufficiently high for the damper c to be entirely closed. The air supplied to the grate is thus shut off and the furnace dampened for the night.



OPENING THE DRAFT ON CHILLY MORNINGS.

The clock is set so that the alarm will go off at the desired time. When the alarm is set in motion, the ring is thrown off the key, the weighted end of the lever b falls and the damper c is opened, allowing a fresh supply of air to pass through the fire. Then steam is soon raised in the boiler and the house is warmed before the people are up.

If it is not convenient to hang the clock above the furnace, the chain may be passed over a couple of pulleys and brought down to the clock which is fastened firmly to a shelf, as shown in Fig. 3. This apparatus need not affect the general working of the dampers at any time after the alarm is off, because the slack chain will allow for the free movement of the lever.

LOST AZTEC SILVER MINE FOUND.

One of the ancient Aztec mines which are believed to have been closed up to keep them hidden from the cruel Spaniards, has been discovered in the Altar district in Northern Sonora. "Con" O'Keefe, the well known Arizona prospector, was the discoverer. When found the entrance to the mine was covered up, the hole by which former operators had entered being walled up with large rocks and grown over with vines and brush.

On effecting an entrance the discoverers found tunnels leading in every direction and tons of silver ore in sight. Tools lay strewn about as if hurriedly thrown aside. In one tunnel ten skeletons were found. It is surmised that the owner of the mine walled these men inside in order to prevent their disclosing the location.

Popular Mechanics

Published by Popular Mechanics Co.
Journal Building, - - - Chicago

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year.....$2 00
Foreign Countries, post paid..... 3 00

Long Distance Telephone Main 2682

Popular Mechanics is an illustrated weekly review of the mechanical and engineering press of the world, presented in plain, simple language, and condensed as much as possible. We always credit publications from which illustrations and facts are taken. Where the name only of such publication is given, it indicates we have used practically the entire article. Where name of publication with date of issue is printed, we have made only a brief digest, and those of our readers who desire to study all the details of the subject should procure from its publishers, or their local newsdealer, the copy of that date

Popular Mechanics is mailed in time to reach every part of the country by Saturday morning.

Make Remittances by Draft, Money Order or Registered Letter. Address,

POPULAR MECHANICS
Journal Building, - - Chicago

Subscribers are requested to give us at least 10 days' notice in advance when any change of address is desired. Doing this will insure their receiving the paper without interruption. Be sure to give old address as well as new.

Advertising forms will close Tuesday ot 5 p. m. for issue dated Saturday of the following week.

Entered at the Chicago Postoffice as Mail Matter of the Second Class.

CLAIMS A SUBSTITUTE FOR STEAM.

Alleged Remarkable Invention That May Work Wonders in Generating Power.

To produce electrical power from coal without the intermediate aid of steam is what Hugo Jone, assistant city chemist of Chicago, claims he has made possible through the invention of new electrical cells. He has constructed an engine and apparatus which he declares will ultimately do away with steam entirely and locomotives and steamships will be propelled without even boiler or steam engine. By Mr. Jone's method the electricity is made from gas, generated from coal. The coal is placed in retorts and from it are extracted its component gases. These are transmitted by means of tubes to the cells where a moist combustion occurs. This chemical action, produced through the action of well-known acids on the gas, generates an electrical energy, which is the equivalent of heat. The power thus acquired is communicated to a motor, which serves the purpose of an engine.

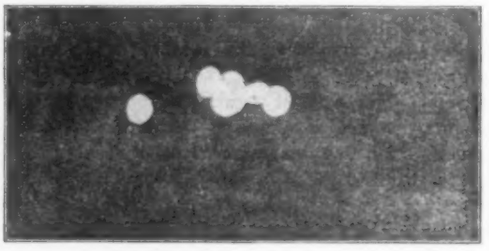
Mr. Jone says: "The new device is a gas battery. The gas can be made from coal, but differs from the ordinary illuminating gas. The yield is 62.5 per cent of the energy of the gas used up in the battery. This is about 2½ times as much as is obtained from the best engines hitherto in use. The ordinary gas engine yields 25 per cent. The best gas engines of least construction yield 28 per cent of the energy of the gas used up. The efficiency of steam engines is still lower, since they produce only about 10 per cent of the energy of the coal which they consume. The comparison is best made from gas engines since they consume gas the same as the new patent battery. The battery is of practical and convenient form and easy to work."

Mr. Jone says that he will give a practical demonstration of his device before city officials and prominent engineers as soon as arrangements can be made.

FIRST PICTURE OF GLOBULAR LIGHTNING.

Mysterious "St. Elmo's Fire" Photographed in Los Angeles.

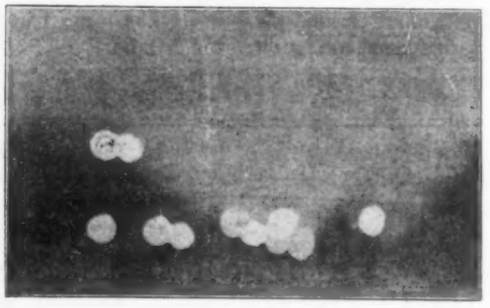
The first picture of "globular lightning" ever obtained has just been taken by J. C. Coney, a train dispatcher of Los Angeles, Cal. Scientists have long endeavored in vain to secure a photograph of this mysterious electrical phenomenon, which



Remarkable Photograph of Lightning.

is most familiar to the tropical heavens. Mr. Coney took his camera out during a thunder storm with the intention of getting a picture of chain lightning. To overcome the blinding flash which often wipes out a plate in one broad expanse of white, he held a piece of smoked glass before the lense. He tried for more than an hour without results and then turned his camera towards the clouds that overhung Mount Wilson and gave a five-minute exposure. The picture that resulted was taken to the Academy of Science and there pronounced the first photograph of globular lightning ever seen.

"Globular lightning" has long been associated with the literature of the French and the Italians by whom it is called



Another View of the Mysterious Lightning.

"St. Elmo's Fire" and "Fires of St. Peter." By the Portugese it is called "Corpos Santos." The early English sailors corrupted this term into "Comazants." In the tropical seas this form of lightning appears in tufts of fire on the masts of ships and in the South Sea Islands the phenomenon is manifested on the tips of soldiers' bayonets. It has even been known to appear on the tips of outspread fingers. The phenomenon is never present save when the atmosphere is in a peculiar state of electrical excitement. In the heavens globular lightning has the appearance of falling from a cloud by its own gravity. It is less brilliant than fork lightning.

PEAT BOGS TO LIGHT IRELAND.

It is proposed to furnish the power to light and heat Ireland, and run street cars and factories from the peat bogs. Electricity is to be the agent and the peat bogs will furnish the fuel. There are 2,830,000 acres of peat bogs of an average depth of 15 feet, equal to 2.552 million tons of coal, and sufficient to furnish 200,000 horse power a year for 531 years. After the removal of the peat the land could be used for farms.

COLLEGE TO EDUCATE MONKEYS.

A college for the education of monkeys has been opened at Calcutta, India. The founders are disciples of Garner and believe that the monkey possesses intelligence in a latent form, which it is the function of the college to develop. It is believed that with proper training the monkey would soon display intelligence equal to that of the average resident of Newport. The system of teaching is that known as the "letter-block" method. The alphabet is arranged on big block letters, all of which are vividly colored. By definite degrees the apes are to be taught to place these letters so as to form words. As they succeed in doing so they will be rewarded with nuts and other dainties.

SLOW PROGRESS IN CLOCKMAKING.

There has been little substantial improvement in the quality of watches and clocks since the 16th century. Few new ideas have been introduced since then. Old ideas have gone out of date, been forgotten and then revived as new. True modern methods have made the work of clockmaking much simpler than it used to be; the clocks and watches are turned out in much greater numbers and with much less manual labor but this has not added materially to the quality of the time piece.

The Revue Chronometrique of Paris says: "It is interesting to study the transformations which have taken place in certain kinds of time pieces at periods widely separated and observe how they come again into mode either in a decadent or improved form. Objects nearly identical with those made before often appear as new inventions and from lack of historical knowledge the makers are not aware of the fact.

The Keystone says: From the 16th century watches have been inserted in earrings; the fashion has never eased though the decorative details have changed according to the taste of different periods."

Mr. Marshall, an engineer of Leeds, Eng., has invented a new locomotive valve gear which is said to be so economical of steam that two engines fitted with it can do the work of three with the old valves and that one-fifth less coal is burnt by the engine so fitted.

WHERE TEXAS HEROES FELL.

Convent of the Alamo, the Most Illustrious of American Ruins.

"Thermopolae had its messenger of defeat; the Alamo had none." All the old missions on the Texas border commemorate bloody fights, but in all the world there is no such a standing monument to bravery as the Alamo. The splendid structural skill displayed in the erection of this edifice a century and a half ago are amazing, but of secondary importance to the story the crumbling walls tell of bravery and loyalty unsurpassed in the history of men. C. E. Fisher, a Texas writer in his interesting story of San Antonio, says:

"Remember the Alamo."

"Here you may yet see the room where Bowie, sick and dying, was lifted murderously on the bayonets of the Mexican besiegers; you may go into the dark hole where the magazines of the Texas boys were stored; you may hear how Evans fell in his last heroic effort; you may see where Davy Crockett's blood spurted across the door sill and through an upper window you may catch a sight of the spot where Travis dropped beside his four cannon."

"Henry H. Windsor, editor of Popular Mechanics, who has made an exhaustive study of interoceanic canal routes, says the next serious volcanic eruption will be from Mont Conseguina, Nicaragua."—The Chicago Tribune.

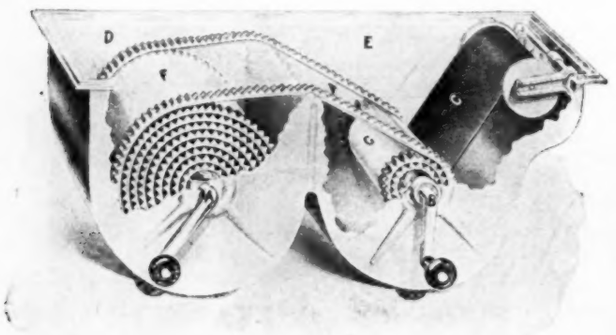
The competition for tractors in Great Britain for military purposes has been postponed until October, 1903. Intending competitors should apply at once for forms of entry for this competition to the secretary, mechanical transportation committee, War Office Horse Guards, Whitehall, London, S. W.

"Popular Mechanics tells in plain language all about the great things in mechanics and is a complete history of mechanical progress. No other publication is like it."—The Kiron (Iowa) Sentinel.

Popular Mechanics "is written so you can understand it."

DEVELOPING PHOTOGRAPHS WITHOUT A DARK ROOM.

The amateur photographer can now take a snap shot, develop his picture and if the sun shines, make a print, all without moving from the spot. This means he can operate a full fledged photograph gallery at a moment's notice while standing on a mountain crag, riding in a railway car, or sailing on the sea. One of the greatest disappointments in photography is

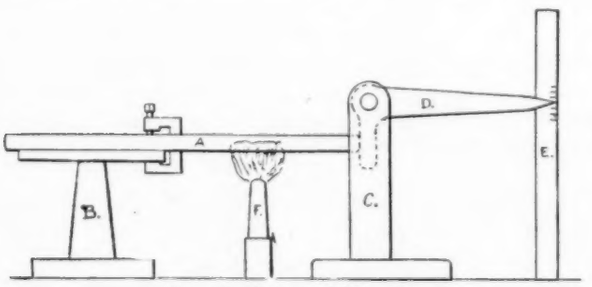


Showing Interior Mechanism of the Developing Box.

when some cherished view fails to develop, or when by an accident in the dark room, it is ruined. The Eastman Kodak Co. has devised a little machine which operates with a crank. It is a portable dark room, and does its work in broad daylight. The roll of film is placed in the box and wound on a drum F, then the chemical is poured into the place marked B, and you are ready to put on the cover and turn the handle. The turning should last four minutes. Then the developing mixture is poured off and the fixer poured in, and after one more season of crank turning lasting five minutes, your films are ready to wash, cut apart, and print. In addition to the speed and convenience the hands are not discolored. It makes no difference whether the picture has had long or short exposure, the machine brings out everything on the entire film.

SIMPLE EXPERIMENT TO ILLUSTRATE EXPANSION OF IRON.

The expansion which takes place in wrought iron and steel when heated is easily illustrated in the following experiment which a writer in the Practical Engineer describes: The apparatus shown in the cut consists of A, a bar of iron about ¼ in. diam. by about two feet long. B, a table or stand to



Shows the Amount of Expansion.

which it is fastened by a clamp, as shown. C is a frame, made with a pocket knife, and supports a bell-crank lever D, one end of which is quite long and pointed. E is a common yard-stick, or a two-foot rule, and F is a strong heat, which applied in about the position shown, will cause the pointed end of the lever to move and show an amount of expansion in exact proportion to the length of levers.

LOCOMOTIVE RAN TWO MILLION MILES.

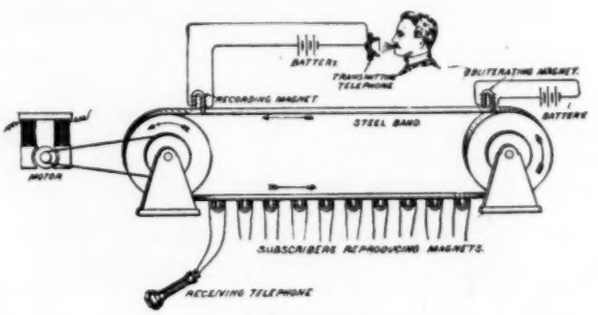
The locomotive "Charles Dickens," built in 1882, and running on the London & Northwestern Ry., has completed 2,000,000 miles of service. The Manchester Guardian says the engine was built at Crews, and that no American locomotive has ever equalled this record.

ELEPHANT WOULD NOT WORK OVERTIME.

In a late number of Animal Life a curious story is told of an elephant employed in an East Indian timber yard. A number of logs had to be moved by him, and only one remained when the bell rang for ceasing work. Of course, the elephant knew the bell and what it meant, and was sauntering away when the foreman bade him move the last log. He did not object, but, with all his tugging and straining, did not manage to lift it. Seeing this, the foreman called up a second elephant to help, but even the two together did no good—the log could not be stirred. It must be left. Next day, to the foreman's astonishment, when the bell rang for beginning work, the first elephant marched straight up to the log, lifted it quite easily, and carried it to its proper place.

A TALKING NEWSPAPER.

They have a talking newspaper in Budapest. It is called a telephonograph for short. The subscribers have a telephone put in the house and when they want to know if anything is doing in the world they take down the receiver and listen. The editor does not write, he talks. Night and day the latest happenings local and foreign are talked into a receiver and transmitted to the thousands of subscribers. The machinery is all



The Telephonograph.

at the editor's office. An endless steel belt is kept in motion by an electric motor. When the news is talked into the receiver the steel belt receives the record through a recording magnet. The belt then passes over as many reproducing magnets as there are subscribers. From these magnets two wires are led to each patron and at the end of the wires is a receiving telephone. After the steel belt has passed the last magnet it is demagnetized and is ready for a fresh message. When new subscribers are received the steel belt is lengthened and more reproducing magnets added. The Mining and Scientific Press says: "During the evening concerts music is frequently given and subscribers who do not care to go to the opera have the opera brought to them."

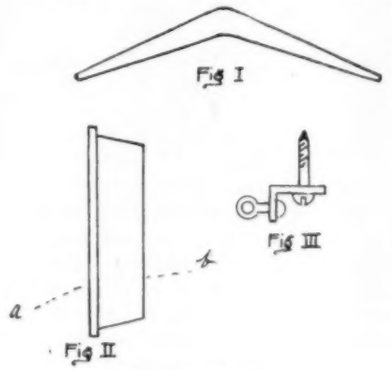
The machine which makes the small oval wooden butter trays or plates used by grocers and butches, turns out about 7,500 finished plates per hour. The plates are 1-25 inch thick so that a block of wood a foot long will make nearly 300 plates. An odorless wood is used.

Popular Mechanics "is written so you can understand it."

THE BOOMERANG AS A LIFE SAVER.

Surprising Results of Test Before Government Crew.

The boomerang heretofore considered of value only as a missile weapon or toy has been harnessed to serve amateur and professional mariners as a life saver. In an exhibition given by Edmond Redmond before a United States Life Saving Crew the performance of the boomerang in throwing a hand line was a source of amazement to all present. It was declared



A Boomerang Outfit.

to be far ahead of the heaving stick because it does not sink, could be thrown much further, with much greater accuracy and does not endanger the lives of the crew that employs it.

The necessary accompaniments in operating the apparatus is a swivel and a faking device. A few minutes practice is sufficient to enable any man to throw the boomerang 150 or 200 feet and carry a line strong enough to lift 30 pounds. Such a cord will haul a person out of the surf or support him until other aid is available. The contrivance should be of great service on board ships or yachts where it is often desirable to send a line to a boat or to a wharf. The whole apparatus does not weigh more than two pounds of which the boomerang is the chief factor. The flight of the boomerang is almost horizontal and, strange as it may seem, it can be thrown nearly or quite as far against the wind as with it. The boomerang seems to fly on the wind and draws the cord end on through the air, thus exposing but a small surface of the cord for the wind to impinge against.

The apparatus can be made by any person skillful enough to whittle out a paddle, from the following directions described by Mr. Redmond: Fig. 1 is an outline of the boomerang which may be about two feet long, half an inch thick and three inches wide at the middle, tapering to two inches at the ends. Fig. 2 is a faking device consisting of the handle a, and wire frame b; the handle is an inch square and two feet long, the wire frame is trapezoid formed, projects from the handle, and on it the cord is to be wound to prevent it tangling, and run off freely when the boomerang is thrown. Fig. 3 is a swivel to be attached on the under side of the boomerang at its center to carry the line.

DEVICE FOR LANDING BIG FISH.

A novel but very successful device for landing large fish is described in Forest and Stream.

A strong strand of steel pianoforte wire in a running slip knot is fixed by means of clips to a semicircular steel hoop; and this, when the lower part touches a fish, after being slipped over the tail, is instantly released and drawn tight round the fish.

The inventor has scored a distinct success, and some of the special advantages he claims are the following: (1) The fish is not damaged as with a gaff. (2) It is much easier to use than a gaff, which latter instrument inevitably requires a certain amount of practice. (3) The fish once snared can be carried anywhere by the tail over sand or high rocks, and has no power to kick. (4) this lander is far superior to any net, for the man who is fishing can use it himself as easily as a gaff, and there is nothing for the tackle to get entangled in as with a net. (5) It can be carried like a gaff, and is also made to screw into any landing net handle.

To use it slip the noose over the fish's

Fig 1

Fig. 2.

Catches the Fish at Both Ends.

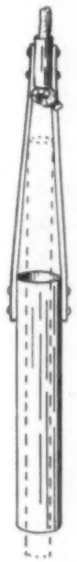
tail behind the dorsal fin, not in front of it, and a sharp jerk upward to the full length of the wire secures the fish.

The artist has not quite hit off the idea in Fig. 2, for the noose should be much nearer the dorsal fin, and then so long as an even strain is maintained it is impossible for the fish to escape.

It takes an oriental weaver a day to produce a single square yard of choice carpet. The new Hallensblen "double-pile" power loom turns out in the same space of time and without the aid of skilled labor 35 square yards of exactly similar carpet.

REMOVING OBSTRUCTIONS FROM DRILLED WELLS.

To remove a fast bucket from a drilled well, writes J. M. Smith in the American Blacksmith, if you know the inside diameter of the bucket, take a piece of square iron that will fit the bucket tightly. Taper the iron so it will easily enter the bucket, and with a chisel cut barbs in each of the four corners When the iron is driven into the bucket the barbs will catch and, unless it be stuck very fast, the bucket can be drawn up.



TO REMOVE PIPING FROM DRILLED WELLS.

For removing pipe, take a piece of casing about three feet long, rivet a piece of heavy wagon tire to each side of pipe, about three and one-half feet long, and bring this together at the top, fastening to a smaller pipe, to which the rope is to be fastened. By driving this down over the pipe, the latter will wedge between the side irons and in this way the pipe can be removed. See illustration.

If this fails, take an old car spring or any good spring steel that is large enough to make two jaws sharp on the end. Rivet these on the inside of the casing at the bottom, so that the jaws reach up inside the casing and come nearly together. When forced over the pipe the jaws will catch, and the pipe can easily be removed.

GOLD BRICK AT HALF PRICE.

Once Uncle Nathan went to town
And bought a brick of gold;
When Uncle Nate undid the brick
He found that he was sold.
"Gol darn my skin!" he cried, aghast;
"This dew beat all, an' yit
I'm glad I only paid thet chap
Jes half he asked fer it!"

BAPTIZED IN HIS COFFIN BOX.

Thomas G. Faircloth, the young white man who was hung for murder at Bronson, Fla., recently confessed religion before he was led to the scaffold. He insisted on being baptized by immersion, and as there was no available tank in the jail, and he could not be taken to the river, the sheriff was at a loss what to do. Finally the undertaker suggested using the watertight wooden box which was to contain the coffin after he was burried. This was found to be large enough, and the baptism was duly administered.

SHOP NOTES

PAINTING THE SMOKESTACK.

R. P. King tells in the American Machinist how he painted five stacks ranging from 35 to 58 feet in height, at an expense of only $16.60. Of this $6.56 was for labor and $10 for 10 gallons of graphite paint. The apparatus used to get a fine

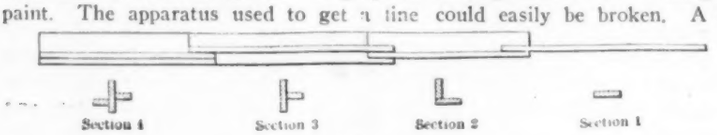


FIG. 2

FIG. 3

FIG. 1

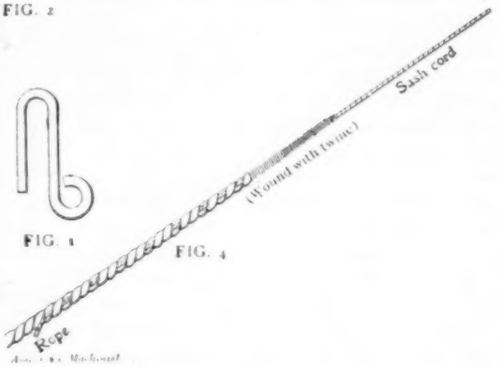


FIG. 4

PAINTING THE SMOKESTACK.

to the top of the stacks is interesting. He says:

First I visited the blacksmith and had him make five hooks of ⅜-inch round iron, like Fig. 1.

It will be noticed that the end of the hook is very deep—about 5 inches—to prevent any possibility of its jumping off the chimney. The eye was about 1¼ inches in diameter, to allow plenty of play for the passage of the rope.

Next, I told the millwright I wanted him to help me, and we made the pole which I have tried to illustrate in Fig. 2. This pole was constructed on what one might call a scientific principle, and was, perhaps, the most noteworthy part of the job. As the highest chimney was a trifle less than 60 feet high, the pole was very conveniently made of 16-foot strips. The upper section was a strip ⅞ by about 2 inches; the second section was a strip ⅞ by 2 inches, with a ⅞ by 1½ strip nailed to it to form an angle shape; section 3 was a ⅞ by 3 inch strip, with a ⅞ by 1½ inch strip nailed on to form a T; section 4 was in the form of a cross, made by nailing two ⅞ by 1½ inch strips to a ⅞ by 3 inch. The laps were about 2 feet, making a pole some 58 feet long. This pole was very light and stiff, and was successful in every way.

A pole as long as 100 feet could be constructed in the same way, which would be strong enough for the purpose and at the same time easily handled. If the sections were screwed together, the pole could be stored in a small space and used from year to year.

Four small holes were next bored in the top of the pole and the hook was lashed to it with twine in such fashion that, while it would stay in place, the lashings were not so strong but that they could easily be broken. A hank of sash cord was procured and run through the eye of the hook, all as shown in Fig. 3.

One end of a long rope was unlaid and the strands cut out to make a good taper about 2 feet long and an end of the sash cord was spliced into the taper. This was in turn wound with twine to make a smooth connection between the rope and the sash cord. The taper was then well covered with soap to make it slide easily through the eye of the hook. Fig. 4 shows this.

It would seem that the next problem was to get the hook up over the top of the chimney, but this was very easy. We placed the top end of the pole on one of the guys and by a proper manipulation of the bottom end had it in an upright position in no time. The hook was then hooked over the top of the stack and one man took hold of the ends of the sash cord to prevent the reaction jumping the hook off when the twine was broken. Another man pulled strongly down on the pole, breaking the lashing and leaving the hook at the top of the stack. A set of light blocks was lashed to the free end of the rope, and by means of a long pull and a few gentle shakes, the rope was pulled through the hook taking the blocks to the top of the stack. The end of the rope was fastened to a post, a board seat was hooked on to the tower end of the fall and we were ready to paint. A whitewash brush on a long handle was used, after removing the rust and scale with a wire brush.

NEW BAND SAW BRAZING APPARATUS.

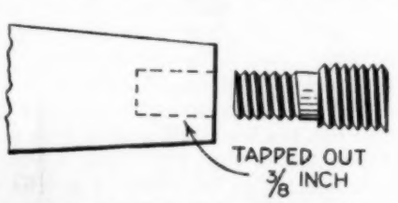
An English journal thus describes a new band saw brazing apparatus: The ends of the saw to be brazed (after being filed obliquely one tooth's length, not more) are put upon the rest of the machine, and fixed by two screws, so that the lap is just in the middle of the pressure plates. The spelter with borax is now placed between the saw ends, and the heating furnace in the middle of the machine (made from fireproof chromottee stone) is put over the lap. The brazing lamp, burning well, is then put on its place, so that the flame just blows through the aperture of the furnace to the saw blade, and in less than a minute the solder is as liquid as water. By pulling the upright lever down, the heating furnace is automatically removed back, leaving the joint free. The pressure plate from below meets the upper plate half way, and the braze, still liquid, is pressed together in a very even manner. In one hour it is claimed that more than twenty joints can be made. The lamp is heated with benzine.

TO CLEAN CLOGGED WATER PIPES IN GASOLINE AUTOS.

The pipes in the water circulating system of gasoline engines used on automobiles often clog up and refuse to work. This is often caused by using water containing much vegetable matter which deposits a thick slime. The Motor Age says the pipes may be cleared by filling the tank with a strong, hot solution of either Babbitt's potash or common soda. Run the engine for a few minutes to allow the solution to do its work, then draw off the solution and refill with water. Again run the engine until the water becomes hot and then draw off. This should be done about once a month to keep the pipes clean under the conditions stated.

REPAIRING THE BROKEN THREAD END OF AN AXLE.

A customer came to my shop with the thread end broken off his buggy axle, says a correspondent in the American Blacksmith. I took an old axle and cut off the



REPAIRING AN AXLE THREAD END.

thread end a little above the threads, drew that end down to ⅜ inch and cut threads on it, as shown in the cut. I then drilled

a hole in the end of the broken axle, tapped it out, screwed in the piece, brazed it, and the result was a solid job.

CONSUMPTION OF IRON IN THE UNITED STATES.

Few persons outside of the iron producing interests have any conception of the mountains of metal that is being turned into useful purposes in this country. Nearly 1,500,000 tons of pig iron is being produced each month; even during the coal strike the output was decreased only about 50,000 tons a month. There are 285 blast furnaces turning out 344,000 tons per week. In addition to this thousands of tons are imported each week, and still small manufacturers are delayed in securing as much pig iron as they need in their foundries.

AMERICANS GREAT INVENTORS.

One would think it well nigh impossible to invent anything, so many patents have been granted, and yet the Patent office steadily reports about 500 patents granted each week. As many more applications are rejected. The total number issued up to October 14, 1902, was 711,454.

As an illustration of how many ideas have been originated during the past 30 years, 20,031 patents were granted for stoves and furnaces. Other articles of as common use are also away up in the thousands. The Yankee does love to hatch out an idea and get a patent, and the patent is all the great majority ever realize from their expectations.

TRAVELING MEAT MARKETS.

A Kansas City packing company has built 12 cars fitted with cold storage for meat, and an office at one end. The cars are 65 feet long and are sent out to supply small towns where it would not pay to maintain a branch store.

"People who talk of the 'good old times' should read some facts that have been compiled by Popular Mechanics."—The Washington Times.

USED UP HIS CHALK.

A boy was called away from this earth and joined the great najority; and when he entered the portals of the upper sphere, St. Peter told him to mount the golden stairs, and, giving him a piece of chalk, directed him to leave on each successive step a chalk mark for some sin he had committed. After advancing a considerable distance, the boy met his father coming down, and said: "Hello, dad! what's the matter? What are you coming back for." "Out of chalk," was the answer.—Charles Emory Smith.

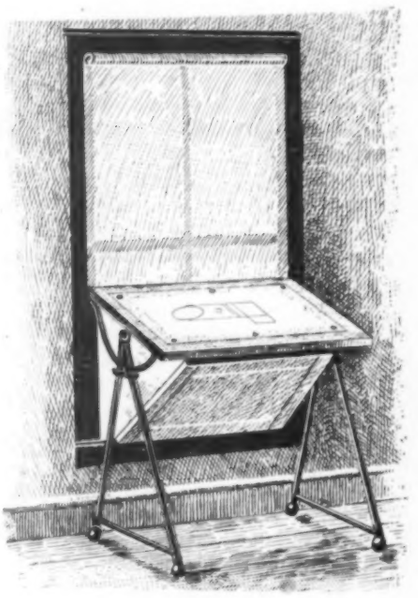
BURNED IN BLAZING FURNACE.

An Italian boy recently met with a horrible death at the mill of the Louisiana Cypress Co., at Harvey, just across the river from New Orleans, La. He was employd at the conveyor that carries refuse to the burner, and in some way got his foot caught in the chain and was carried and hurled into the blazing furnace, his body being burned to a crisp before the fire could be extinguished.

APPARATUS FOR COPYING DRAWINGS.

Twenty years ago the blue print drawings now made by the thousands, were seldom seen, and not favorably regarded by many European engineers. Hand made drawings, made one at a time were considered better and usually insisted on. A correspondent of the American Machinist tells of a simple home made device he used, when given a job many years ago, to reproduce 100 copies of the same tracing, to be "hand made drawings on white paper." He says:

In place of a drawing board I had an open frame made of soft wood, into which was set a light of glass so as to flush with the top of the wood. The glass was larger than the border line of the drawing, but smaller than the whole sheet, so that the original plan could be placed on the glass and the paper stretched over it and fastened by drawing tacks in the soft-wood frame. The drawing table was backed up against a window, the curtain drawn down to the drawing board, to keep out the top light, and a mirror or a sheet of white paper placed at an angle underneath the glass, so as to throw the light up through the drawing. Under these circumstances copying can easily be



Home Made Device for Copying Drawings.

done through paper as thick as Patent Office board, and it is not necessary for the direct sunlight to strike the mirror; even diffuse daylight will answer.

The Yosemite State Co. has undertaken to overcome the dust nuisance by oiling the stage road 70 miles long from Raymond, Cal., to the Sentinel Hotel in the Yosemite valley.

Rabbit skins for the manufacture of felt hats are shipped to the United States in large quantities from Birmingham, Eng. One dealer handled 3,000,000 skins last year.

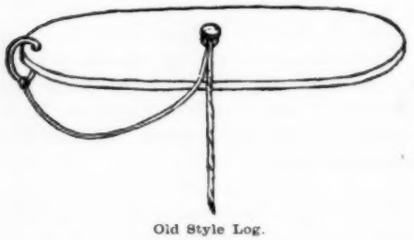
Textiles Building, St. Louis World's Fair.

"KNOTS" AND THE OLD STYLE LOG LINE.

Editor Popular Mechanics: A recent reference to nautical "knots," suggests to me that many of your readers may be interested in a further explanation.

There are two kinds of miles, viz.: geographical and statute miles. Sixty geographical miles or 69¼ statute miles make a degree. A geographical mile contains 6094 feet. A statute mile 5280 feet. Distances at sea or the speed of a ship is reckoned in geographical or "nautical" miles as sometimes called. A knot is a nautical term which originated with the use of the log line, a device for determining the speed of a ship at sea, probably the most primitive method used. The log line contained several hundred feet and in size was usually ¼ inch in diameter and was placed on a reel. To the end of the line was fastened a piece of wood or log as it was called, which was thrown overboard and remained stationary on the water while the ship passed on its way unwinding the line from the reel. The first hundred feet or so of the line was free of marks and was called "spare line," the purpose of which was to allow the log to get beyond the ship's eddy or suction. Then came the first mark, a piece of colored cloth placed in the "lay" of the line. When that passed off the stern of the ship, the word was given to turn the sand glass which an assistant held ready.

It was so calculated that if a certain number of feet of line passed out while the sand was running down, the ship was



Old Style Log.

sailing one mile an hour, at which point on the line a small cord was run through the line having one knot in the end. The remainder of the line was divided in portions equal to the first and marked by cords whose knots increased by one in consecutive order. Hence the phrase "The ship is sailing so many knots an hour."

It is claimed that some of the ocean liners can speed twenty-two knots an hour, which equals 25 miles 2068 feet if measured on the land.

The line was attached to the log, as shown in the sketch, to prevent a slight tension on the line pulling the log through the water. The rope was first fastened through a hole in the end, then to a plug which fitted into a hole bored in the side at the middle of the log. A smart jerk would release the plug and the log would be pulled to the ship endwise.

C. W. Sherwood.

Chicago Heights, Ill.

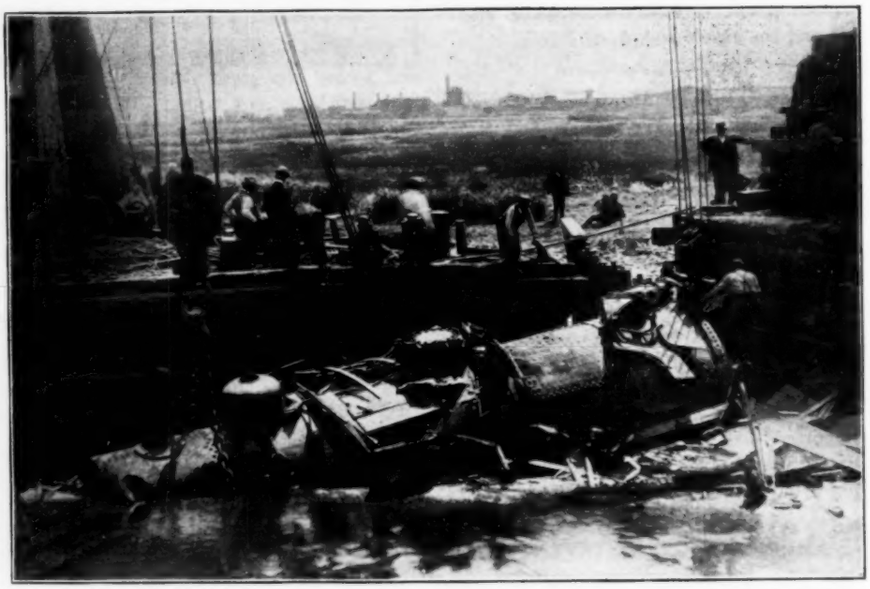


Fig. 1.—This Locomotive went through an open draw bridge on the Central Railway of New Jersey.

SEES PERIL IN UNION OF LABOR.

By the Rev. Dr. Newell Dwight Hillis, of Plymouth Church, Brooklyn, N. Y.

Just now our country is entering upon a crisis that is to strain its institutions to the last point before breaking. A century ago the great figures of the community were the magistrate and the minister. In the middle of the last century the statesman and the politician were the outstanding figures, representing the weight of intellect and these were the days of Daniel Webster and Henry Clay.

Then came an era about five years ago when the statesman was submerged by the multi-millionaire. Wealth, riches, the love of gold and power, control our statesmen now. Individuals representing hundreds of millions caused the politician to pass under an eclipse. This Croesus, who once owned his private car and yacht, now owns his private governor, his private representatives, and last summer he owned his private congress.

Now has come a day when the multi-millionaire is powerless to control the treasure he has gained. The next stage is his submergence by the numbers of his workmen acting under the control of a single will. But the rule of the many because they have the votes and are needed by the governor who seeks re-election is a rule of peril that threatens every institution that we love.

A KANSAS CORN STORY.

The horrible news comes from Blue Rapids, Kan., that near that town Willie McKeighoh climbed a pet corn-stalk to see how the corn was getting along, and the stalk is growing up faster than the boy can climb down. The boy is plumb out of sight. Three men have undertaken to cut down the stalk with axes and save the boy from starvation, but it grows so fast that they can't hack twice in the same place. The boy is living on nothing but raw corn, and has already thrown down over four bushels of cobs. The latest reports are that the stalk has attained such a dizzy height that the cobs now catch fire and are consumed before reaching the earth.

FEMALE FIRE FIGHTERS IN NEW YORK.

The only woman fire department in the world is in New York. It is composed of the sweet-faced nurses of Bellevue hospital. Because of the great responsibilities that would devolve on these young women in caring for the patients in case of a conflagration, it was deemed advisable by the management that they should be drilled in the work of fire-fighting and life-saving. They have become quite efficient as a result of the weekly exercises, and many of them can now scale walls, and carry patients down a fire escape as readily as many men. Dr. Stewart, superintendent of Bellevue says: "These young women will be held responsible for the safe removal of patients in case of fire."

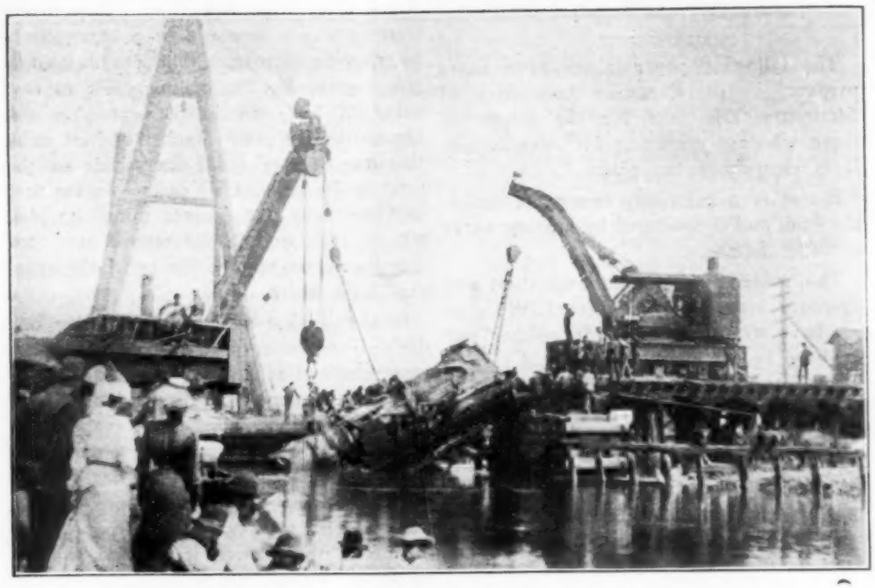


Fig. 2.—Raising the Locomotive—Illustrations by courtesy of The Railway Conductor.

WHY A BARREL IS STRONG.

The barrel is based on a scientific principle, a most important feature of which being that (excepting on the flat of the head), no matter how taken, it presents an arch, says the National Cooper's Journal. However large a barrel or cask, when resting on its bilge it can be handled most readily, owing to the small surface in contact with the ground upon which it rests. It is at all times a live package, and proportionate to its own weight it is capable of containing and supporting a greater weight and greater pressure, both from without and within, than any other package possible of construction. Its staves and heading are composed of a great number of segments, all varying in the grain, the strength of one sustaining the weakness in another.

GALVESTON RISES FROM ITS RUINS.

Like Chicago, Galveston, Texas, has risen from its ruins and the renewed energy its citizens are putting forth promises to make the island city greater than ever. The people of Galveston have not yet completed the wall, 17 feet above mean high tide, resting upon piling driven into the ground from thirty to fifty feet, which is to protect the city against the rush of the waters of the Gulf in future hurricanes; but they are doing business. Thirty-one lines of steamers ply between Galveston and foreign ports. The total shipping business for the year ended August 31 was valued at $260,837,354—a gain of $14,270,107 over the previous year. The exports of cotton footed up 1,901,256 bales, valued at $83,326,777. The value of foreign imports for the year was $1,733,188—a gain of $759,219 over the preceding year.

The Galveston News says:

The feature of the year was the coming of the Southern Pacific shops. Every manufacturing industry of Galveston of any consequence has begun the use of oil for fuel. It is used by the harbor fleet, by the railroads and by the city. The advent of cheap fuel has resulted in an effort to secure additional manufacturing industries. During the past year Galveston has advanced from fifth to fourth place in its rank among United States ports in the value of foreign exports. The port has also advanced one point in its rank among United States ports in the value of import business.

ACCIDENTS ON AMERICAN RAILROADS.

Commissioner Walker of London in his report to the London & Northwestern railroad, on the result of his late investigation of American railroads, says that in the United States "human life seems to be of considerably less importance" than in England; that the American roads "have nothing to boast of either in the safety of their passengers or their employes." The report quotes the interstate commerce commission to show that in the year ending June 30, 1901, 2,546 employes were killed and 33,711 injured as compared to 2,550 killed and 39,643 injured in 1900. In 1901 the number of passengers injured was 6,098, or 1,861 more than in 1900, and the number of killed was 303, which is 54 more than in the preceding year.

"I read Popular Mechanics because I find so many things in it that are interesting and of help to me. It is the only one of those kind of papers that I can understand."—Lillian Russell.

MUNICIPAL OWNERSHIP IN GLASGOW.

By Dr. Frank W. Gunsaulus, President of Armour Institute of Technology.

During my recent trip abroad I gave some study to municipal and civic issues. In Glasgow, Scotland, I found that the city owned its street railways, its water system, its lighting system, and while I was there the city was discussing the advisability of having municipal dairies. Pure water came with municipal ownership, why not pure milk, also? That was the line of reasoning of those who favored the plan. All the utilities owned by the city are paying investments.

There is no doubt that municipal ownership of public utilities in Glasgow is a wonderful success—just the sort of a success it will be here some day. But there is a preliminary step. Municipal regeneration must precede municipal ownership. Are American cities able to conduct utilities as Glasgow does? That is the question. Our first efforts should be, not to get the utilities, but the men to handle them. We must first get the right men in office to manage these public properties on business principles.

SELF-INFLATING LIFE PRESERVER.

A novel life belt, the invention of a Frenchman, is described in Armee et Marine. It consists of five packets of waterproof cloth and a small flat box of aluminum containing 50 grams of carbide of calcium. It is for use by soldiers who must ford rivers. The belt is worn under the arms. On plunging into the stream, water enters the box through a valve and acetylene gas is instantly generated, inflating the belt and easily floating the wearer.

A LONG-FELT WANT.

"I have here," said the long-haired theorist as he was ushered into the presence of the railway magnate, "plans for a device that will warn the engineer when any one is crossing the track."

"Can't use it," replied the busy official. "What we want is something that will warn the person who is crossing the track when the engineer happens along that way."

BOUGHT A $2,000 WALNUT LOG FOR $75.

A resident of Greencastle, Ind., owns a walnut log for which he recently refused an offer of $1,500. He found it while making an excavation on the bank of a creek and bought it from the owners of the land for $75. The timber appears to have been covered for centuries and is as black and hard as mahogany. The present owner values the log at $2,000.

If you wish to learn how you can secure the backing of

$600,000.00 Capital

And the

Best Legal Talent

Anywhere in the United States to protect you against

Infringement

Losses or Litigation Expenses for

A Nominal Fee

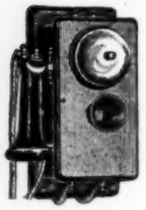
Drop a postal card and receive full particulars

Pacific Patent Protection Co.

Mills Building, San Francisco, Cal.

Offices and Auxiliary Counsel in leading Cities.

Complete Telephones $3.00



Have a Phone in each department—have one at home—is convenient—saves time—saves money.

Write us at once or

PHONE HARRISON 2964

Electrical Material Co.

167 E. Van Buren St.

Chicago

Choice Selected Winter Apples

FOR SALE

Of all the leading sorts and best keepers, put up for family use.

PRICE, $2.00 PER BARREL

Delivered to freight depot. Address

F. E. GILBERT, - - Erie, Pa.

THE MIDGET DYNAMO OR MOTOR

Weight 3¾ pounds. Will light our 6 c. p. lamp, ring bells, explode powder. Output 10 watts. As a motor will develop 1-32 h. p. Wound for voltages 4 or 6 as desired. Other voltages up to 110 to order. *Send 2-cent stamp for illustrated circulars.*

ELBRIDGE ELECTRICAL MANUFACTURING COMPANY,

Elbridge, N. Y., U. S. A.

One man in each good sized shop can, at noon and without any expense earn a set of the

MECHANICAL LIBRARY FREE

It is the best work of the kind ever published and like Popular Mechanics, is "written so you can understand it." Contains 10 vols., 4,000 pages, 2,000 illustrations. Just out. Do you want to know all about ? Then write Popular Mechanics.

How to Run a Locomotive

Written by a locomotive engineer. Sent postpaid. PRICE, $1.00

227 Monroe Street, - - Brooklyn, N. Y.

ATTENTION

GENERAL MANAGERS, GENERAL SUPERINTENDENTS, CHIEF ENGINEERS, MASTER MECHANICS, ETC.

We have on hand a very fine list of Draftsmen, Engineers, Electrical Engineers, Civil Engineers, and Specialists in all walks of life.

THE SCIENTIFIC EXCHANGE

ROOM 418, 134 VAN BUREN ST.

THE GENERATION OF STEAM.

The following paper is one of a series prepared by the Canadian Association of Stationary Engineers for the benefit of those who are preparing for examination. It is elementary but plain.

Steam is a colorless, expansive, invisible fluid, and is produced by heating water or other liquids.

The subjects of steam and heat are therefore very closely connected. We cannot have steam without heat, neither can we have heat without motion, and this is one of its great factors of usefulness to mankind. Our steam engines then are in reality heat engines, and the steam is the medium by which the heat is carried from the coal to completed work at the engine cylinder. We say steam is an expansive fluid, and in this expansion is its great factor of usefulness to us. If we take water at 32 degrees F., and add 180 heat units to it, under our atmospheric pressure it boils, and its temperature is 212 degrees F. Up to this point we can measure the heat with a thermometer; this is called the sensible heat of steam. We also have what is called the latent (or lost) heat of steam; this cannot be measured by the thermometer and comes about in the following manner:

If we take one pound of water at 32 degrees F. and apply a fixed and known quantity of heat to it until it boils, we will assume that it takes 20 minutes, and we have supplied the water 180 heat units, which added to the 32 contained in the water at the start makes 212 degrees F. or heat units, and is the sensible heat of steam at atmospheric pressure. Now let us continue the same quantity of heat per minute until all the water has evaporated into steam and we will then find that it has taken five and one-third times as long, or 10 minutes, to do this work. Consequently we have used 5 1-3 times 180, or 960 heat units; or, to be exact, it is 966 heat units. Now the temperature of the steam is the same as the water from which it was evaporated, or 212 degrees F., and this 966 heat units is the latent heat of steam at atmospheric pressure. All steam has a sensible heat corresponding with the temperature of the water it is evaporated from. If you boil water under a pressure of 5 atmospheres or 75 pounds pressure, the sensible heat is 306 degrees F., the boiling point at that pressure, but the latent heat has decreased by the same number of heat units that the boiling point increased, so the total is the same in all cases. In the first case we have 212 degrees minus 32 plus 966 or 1146, and in the second case, 306 degrees minus 32 plus 872 equal the same 1146 heat units.

In evaporating our pound of water under atmospheric pressure, the temperature remained at 212 degrees, but the volume was increased to 1644 times that of the water in the second case; evaporating under 75 pounds pressure the temperature also remained the same, 306 degrees F., but the volume is only 295 times that of the water it was evaporated from. This is one of the reasons it pays to run an automatic cut-off engine.

The expansion of steam follows what is called Marriott's law of expanding gases, which summed up means one-half the pressure doubles the volume. So if we let steam into an engine cylinder at 80 pounds pressure, and cut it off at one-fourth stroke, it is at 80 pounds up to the point of cut off; at one-half stroke, because it has doubled its volume, it is reduced to one-half pressure, or 40 pounds; while at three-fourths stroke the volume has trebled and the pressure has dropped to nearly 27 pounds, and this is why it is economical to run engines that use steam expansively. Steam at 27 pounds pressure is very much cooler than steam at 80 pounds, and this difference in its temperature has been converted into mechanical work by our steam (heat) engine.

Of the latent heat that disappears in the formation of the steam we can recover a great part of it again when steam returns to water, that is, it gives up its latent heat when condensed. That is one reason why steam is a good medium to heat our buildings, and also a good reason why it requires so much cold water to condense the steam back to water quickly as in an engine movement. Steam also has a very rapid movement. It will flow under a pressure of one and one-half atmospheres into the air at a velocity of 67,500 feet per minute, and into a vacuum from

CENTURY MF'G CO.

PRICE **$33.50**

It will pay you to send for our Catalogue No. 6, quoting prices on Buggies, Harness, etc. We sell direct from our Factory to Consumers at Factory Prices. This guaranteed Buggy only $33.50; Cash or Easy Monthly Payments. We trust honest people located in all parts of the world.

Write for Free Catalogue.

MENTION THIS PAPER.

DEP'T P. M. East St. Louis, Ill.

a pressure of one atmosphere at the rate of 114,540 feet per minute, or 1,242 feet per second. This is why a steam pipe and the steam ports of a cylinder may have a very much smaller area than the piston itself, and the rate of flow of steam in pipes is how their sizes are determined. The whole science of the intelligent use of steam is to save, utilize and direct its heat. An economical 80-horse-power automatic cut-off engine using 30 pounds steam per horse power hour, and discharging into the atmosphere at a back pressure of one pound per square inch, will discharge heat enough to supply 9,000 square feet of radiating surface, or enough to heat a building containing 720,000 cubic feet of space.

ALUMINUM ALLOYS A GOOD SUBJECT FOR EXPERIMENT.

In the paper read by Professor Ernest Wilson before the recent meeting of the British Association, the author dealt with the effect upon electrical conductivity of exposing certain light aluminum alloys to the London atmosphere. He pointed out that, if commercially pure aluminum be alloyed with only a small percentage of copper for the purpose of increasing its tensile strength, exposure diminished electric conductivity, possibly by electrolytic action at the surface. If, however, in addition to the copper, a small percentage of nickel be added, no such diminution in conductivity took place, and the tensile strength was increased, says Shipping World, London.

The discovery that metals which alloyed alone with aluminum might produce unfavorable effects, but which in combination proved beneficial, might have practical importance in other than electrical branches of engineering. From this it would appear that the physical properties of aluminum alloys are still little understood, and the subject is one of great interest to engineers in general.

The number of pupils enrolled in all the educational institutions of the United States last year was 17,299,000, an increase of 278,000 over the previous year.

SHE WAS A REAL ANGEL.

Where Peter guarded heaven's gate
A woman came, one day,
And meekly knocked and meekly said:
"Oh, let me in, I pray!"
And many a fairer one than she
The good old saint had sighed to see
Forever turned away.

"And why," he asked, "should I unbar
The gate to let you in?
Is there upon your heart no scar,
And did you never sin?
Nay, look me fairly in the face
And hurry up and plead your case—
I'm waiting—come—begin!"

"Ah, yes! I must confess I sinned,"
The one without replied;
"To keep from paining others I—
Well, often, sir, I lied!
But pray do not condemn me yet,
I have some virtues I would set
Up on the other side!

"I didn't hate my husband's folks,
Nor run them down," said she;
"I let him love his mother, and
Be kind to her, and he
Could talk to other women who
Were young and blithe and comely, too,
Without offending me.

"I never, never made him wait
A dismal hour or two;
When he and I agreed to meet
I got there!—And I threw
No slurs nor ever tried to taint
The names of pure—" "Ah," said the saint
"Come in, you angel, you!"

—Railway Conductor.

DEATHS FROM TROLLEY CARS.

Emperor William of Germany in speaking of the recent accident to President Roosevelt said: "Electric cars are the enemies of humanity." Since Jan. 1 the persons known to have been killed by electric cars in this country are 326; the injured, 1,316. Probably the number is much greater for the car companies always endeavor to keep such information from the public. The number of accidents grows proportionately greater with the rapid increase of trolley mileage. Comparatively speaking the fatalities are as great, if not greater, than those caused by the steam railroads.

Popular Mechanics want ads are read wherever the English language is spoken.

FOUNTAIN PEN and FILLER — SEND 10 cents Stamps or Coin

A Miracle of Ingenuity

This is a special offer to call Your attention to my

Solid Gold Fountain Pen — $1.00 Money Order, Stamps or Coin

E. Y. HORDER, Fountain Pen Agency,
149 Washington Street, Chicago.
Back numbers of the Popular Mechanics always in stock.

FIRE A LOCOMOTIVE

Thorough Home Instruction. Assistance to Employment.
Railroads need many thousand instructed Firemen annually. GOOD PAY and chance to become an Engineer. ENROLL NOW for the great Fall increase of force on all rail roads. *Particulars free*
The Railway Educational Association
STATION I, 10 BROOKLYN, N. Y.
Reference as to Reliability, The Bedford Bank, Brooklyn.

Patents and Patent Law

BENJ. T. ROODHOUSE
DAVID P. MOORE

Chicago Office:
No. 908 Chicago Title and Trust Co. Building
CHICAGO, ILL.

Washington Office:
Washington Loan and Trust Building
WASHINGTON, D. C.

Mention Popular Mechanics.

WOOD or METAL Workers

Without Steam Power should use our Foot and Hand Power Machinery. Send for Catalogues
A—Wood-working Machinery,
B—Lathes, etc.
SENECA FALLS MFG. CO.
102 Water St., Seneca Falls, N.Y.

Did You Ever Use Press Clippings?

Do you want to know everything possible about anything? Want clippings of every article published on any topic in the American or Foreign press, weeklies, dailies, magazines and trade papers?
Want to obtain early advantage of a trade situation?
Want the quickest news of proposed new stores, bridges, factories, conventions, clubs, incorporations?
Want to compile a scrap-book on a special subject?
Want to prepare a response to a toast; speech in a debating club or elsewhere; paper or essay in literary club, or anything of that nature?
The easiest, surest, quickest, most economical way is to secure the services of our large staff of trained readers.
BUSINESS MEN are using clippings and get reliable tips which lead to business on the "follow up" plan. Tell us the nature of your business and we will supply valuable clippings of new items daily that will aid you in making that business profitable. $1.00 a month and upwards.
United States Press Clipping Bureau,
153 La Salle St., Chicago, Ill.
Send stamp for booklet.

PIANOS, ORGANS AND SEWING MACHINES ON FREE TRIAL!!!

ELEGANT CENTURY UPRIGHT PIANO, $125. Warranted 25 years; sent on free trial.
ELEGANT PARLOR ORGANS, $25 UP. Warranted 25 years; sent on free trial.
ELEGANT CENTURY SEWING MACHINES, BALL-BEARING, $13. Warranted 25 years; sent on free trial. CASH OR EASY MONTHLY PAYMENTS.

FREE!

We trust honest people located in all parts of the world.

Direct from factory to homes at factory prices.

FREE.

WRITE FOR FREE CATALOGUE.

CENTURY MF'G CO. DEP'T 758 East St. Louis, Ill.

SHARPEN YOUR OWN TOOLS

Don't waste time and money carrying them to town. You can do it better yourself at home with

THE TROJAN GRINDER

Sharpens knives, sickles, chisels, scissors, skates, in fact any tool or blade that takes an edge or point. 4¼ x 1½ Emery Wheel of best quality, fitted with guide to hold tool true.

SEND $3 50 TODAY

or write for free circulars State choice of Stone—Coarse, Medium, or Fine. Thousands are buying it.

3000 revolutions per minute with scarcely any exertion.

ALCOCK COMPANY,
98 E. 22nd Street, Chicago, Ill.

"Electrical Experiments"

We can supply back numbers containing the popular series

EASY EXPERIMENTS IN ELECTRICITY. HOW TO MAKE.

Simple Galvanometer.....Jan. 18
Box to Hold Battery.....Jan. 25
Tangent Galvanometer.....Feb. 1
Powerful Magnet.....Feb. 8
Induction Coil.....Feb. 15
Simple Electric Motor.....Feb 22
Electric Circuit of Water.....March 1
Voltmeter .....March 8-15
Storage Battery.....March 22
Simple Telephone.....March 29
Electric Motor 1-20 H P.....
.....April 5, 12, 19, 26; May 3, 10
Set of Telegraphic Instruments.....
.....May 17, 24, 31; June 7
A Dry Cell Battery.....June 14
Practical Telephone....June 21, 28; July 5, 19
Measurement of Resistance...July 26, Aug. 23
An Electrophorus.....Aug. 2
Electric Condenser.....Aug. 9
Laboratory Storage Battery...Sept. 20, Oct. 4
Rheostat.....Oct. 18, Nov. 1

Price 5 cents per copy, pos paid. Popular Mechanics, Journal Bldg., Chicago.

"Want" and "For Sale Ads. 2 cents per word payable in advance. Replies may be sent to a number, care Popular Mechanics and will be forwarded promptly without extra charge.

BUSINESS CHANCES.

FOR SALE—Marble and granite business in Southern New Hampshire Practically no competition in town, and no shop in other towns within sixteen miles. Alice H. Hersey, Petersboro, N. H.

A BUSY MILL at a bargain. For full information, description and price of the best located mill in the state address Box 63, St. Charles, Minn.

BAKERY—Only one in county seat. Population 2,000. Clear $1,500 per annum. Sell at invoice. Box 690, Black River Falls, Wis.

TO RENT—A desirable photograph gallery at Petersburg, Ill. Rent low. Correspondence solicited. D. S. Frackelton.

FOR SALE—Only steam laundry in town; two railroads; rent cheap. New machinery and good place for agency work. Steam Laundry, Chatsworth, Ill.

PATENTS OBTAINED—New book on patents free, 425 Popular Mechanics.

FOR SALE.

EXCHANGE—Stereoptican with 90 views to exchange for Motor Bicycle or 2-Day Marine Chronometer. G. W. Casteel Texarkana, Ark.

SALE OR EXCHANGE—$850 Baldwin Steam Carriage, practically new, $400; Duryea Gasoline Carriage, cost $1,000, fine shape, $425; Motor Cycle, like new, $85, cost $150; 6-h. p. Double Cylinder Carriage Motor, $125; $350 Motor Tricycle, $175; 7-h. p. Stationary Steam Engine, $40; Lock Regulator, $4; Cycle Motor, $20; 17 in. Iron Bed Wood Lathe, $50; Good Shaper, $85; 8 in. Universal and Indant. Comb Lathe Chuck, $6; ½ in. Drill Chuck, $3.50; 3-h. p. Motor Casting, $20; 1¼-h. p. Cycle Motor Casting, $9; Fine Set Tinner's Tools, cheap; Fine Complete Nickle Plating Plant, cheap. Buy, sell or exchange for Stationary Engines, Autos, Motor Cycles or Motor. T. S. Culp. Canton, Ohio.

FOR SALE—New 2-h. p. Marine Gasoline Motor, ready for boat, except tank. C. N Cady, Canastota, N Y.

FOR SALE—Formula for manufacturing a cereal coffee, proved to be a specific for neuralgia, etc., caused by low state of health. Better profits than cereal food. First cost is same, less of it to make, and sells for as much. No expensive machinery required. What offers? Address, B., No. 25 Pearl St., Battle Creek, Mich.

FOR SALE OR EXCHANGE—A drug stock and fixtures, first class, clean stock, good location. Missouri town, population 7,000; will reduce stock to suit purchaser. Address, Drawer "G," Trenton, Mo

PERPETUAL MOTION—how it can be done; book and drawings for three complete machines, 25 cents, coin or stamps. Address, No. 520, Popular Mechanics.

500 AGENTS WANTED at once to sell the inkless pen. Biggest seller ever invented. More commission paid than any other agents' article. Failure to sell impossible. Send 10 cents silver for sample and outfit. Address Robert Winton, Commerce, Texas.

FOR SALE at a low price; necessary patterns, core boxes and tracings of four-cycle motor cycle gasoline engine. On receipt of $1 I will send complete set of blue prints, with full particulars. Jos. H. Ferodowill, 86 W. 7th Street, St. Paul, Minn.

FOR SALE OR EXCHANGE—A good business in one of the best growing cities of 9,000 population in U. S. Average daily cash sales $200; yearly net profits $6,000. Business could be doubled. Stock of general mdse. will invoice $18,000. Will take small farm in part pay. Address 515, Popular Mechanics.

BAKERY—With two-barrel mixer, brake, six-horse power gasoline engine. Doing a wholesale business, in a town of 8,000 with railroad shops and coal mine. Address Box 801. Trenton, Mo.

SURPLUS STOCK of pure-bred Golden Pheasants of early 1902 hatch. With each pair a booklet is given, telling how to care for and rear pheasants. Dr. Geo. W. Little, Glens Falls, N. Y.

FOR SALE—Owner going west; 10-room house, barns, all kinds of fruit, 30 acres land, including small lake; ideal summer home, 18 miles from Chicago; electric line will pass premises. For sale at a great bargain. Address 510 Popular Mechanics.

FOR BLACKSMITHS—$25.00 tempering receipt for $1.00. Drill can be made hard enough to drill file. Henry Austin, Jacksboro, Texas.

FOR SALE—Three-story brick house, on one of Chicago's finest residence streets of South Side; lot 35 x 125 feet; transportation facilities excellent. Will sell at a bargain. Address 600 Popular Mechanics.

FOR SALE—Telephones; give perfect satisfaction; magneto call; solid back transmitter; watch-case receiver. Best on the market for the money; will talk three miles. Only $4.00 each. For sale by 503 Popular Mechanics.

FOR SALE—1902 Model bicycle—never been used; all the latest improvements and equipment. Price $20.00—just one-half original cost. Address 508 Popular Mechanics.

FOR SALE—193 acres conveniently improved, located in Mills County. Water, grass, timber, orchard, 4-room dwelling. Price, terms on application. W. M. Keith, Star, Texas.

FOR SALE—Farm, $70 per acre, 322 acres all plow land. Good buildings. Rural delivery. Telephone; five miles woven wire fence. This is rich bottom land with clay sub-soil, situated only 60 miles west of Chicago, in Illinois. No better farm in the state. N. L. Jackson, Belvidere, Ill.

MACHINERY.

FOR SALE—A ⅛-h. p. dynamo. Photo for stamp. Roy A. Crihfield, Lincoln, Ill.

HELP WANTED—Steel range makers and mounters and stove plate moulders at Chicago Heights. Bonnet-Nance Stove Co.

CASTINGS AND BLUEPRINTS, 5 sizes boat and sta. 2-cycle gasoline engines; also completed engines; tested, successful. Hildreth Motor Co., Lansing, Mich.

HELP WANTED.

WANTED—At once, a good tinner, on roofing, guttering and spouting, putting up stoves, etc.; good job for right man. Only sober and industrious men need apply. Healthy climate, very mild winter. M. J. Williams, Baton Rouge, La.

WANTED—Steel range makers and mounters and stove plate moulders at Chicago Heights. Bonnet-Nance Stove Co.

PLUMBER AND TINNER.—I am in need of a sober and reliable man that can do plumbing, hot water and steam heating; hot air furnace work and tinning; to such a man good wages and steady employment will be given. W. B. Frymire, Bloomfield, Neb.

POSITIONS WANTED.

WANTED—Situation, general traveling agent or salesman. Must be first-class to be considered. John H. Lake, Burlington, N. J.

YOUNG MEN who want to embark in business will find a valuable medium in Popular Mechanics Want Columns.

CHARTERS.

"THIS BEATS NEW JERSEY"—Charters procured under South Dakota laws for a few dollars; write for corporation laws, blanks, by-laws and forms, to Philip Lawrence, late assistant secretary of state, Huron, Beadle Co., South Dakota.

AUTOMOBILES.

FOR SALE—4 h. p. Automobile Engine Olds model transmissions, circulating pumps and spark plugs. W. B. Murray, 1253 Milwaukee Ave., Chicago, Ill.

FOR SALE—In A1 condition, a DeDion Automobile, cost $1,350, will sell for $550 shop tools. Auto, Box 613, Collinwood, Ohio.

FOR SALE—One 4-h. p. Otto; one 10-h. p. Otto; one 12-h. p. Lambert; one 22-h. p. Fairbanks; one 54-h. p. Fairbanks; one 20-h. p. New Era; one 26-h. p. New Era; one 35-h. p. New Era; one 60-h. p. New Era. I buy, sell or exchange. J. Montgomery Johnston, 216 Lake St, Chicago, Ill.

FOR SALE—1 Columbia Mark XIX electric surrey with new Exide battery, but little used and in A-1 condition. For price and information write Geo. H. Kilker, Hebart, Ind.

SPECIAL.

COME TO WARSAW, Kosciusko Co., Ind.; 100 miles from Chicago for a good farm; 40 acres $1,700; 80 acres $4,000; 160 acres $9,000; 200 acres $12,000. These farms are o. k. On Rural Route and near schools. See N. N. Boydston, Dealer in Real Estate, Warsaw, Ind. Write him for anything you want.

40 ACRES wild land in Polk Co., Florida. What offer? M. Johnson, P. M., Macwahoc, Me.

("BOOK OF 3,000 RECEIPTS," for the workshop, laboratory, etc. No mechanic should be without this valuable book; over 350 pages. Price, 30 cents. Western Specialty Co., 653 Burr St., St. Paul, Minn.

$5,000 WILL BUY a beautiful home in Southern California, set to fruit and paying from 15 to 20 per cent. on the investment. English walnut, orange and lemon groves. Mild winters, cool summers, fine roads, good schools and churches. Write to Randall, Morse & Co., Santa Ana, Calif.

Would you like to correspond with traveling salesmen covering the territory of Illinois, Indiana and Ohio, calling on the hardware and implement trade in regard to handling side line? Address Fitch Manufacturing Co., Wayland, Mich.

IF YOU WANT a machine, tool, or anything in a mechanical line and don't know where to get it, write Popular Mechanics.

FOR SALE—Cheap, two hand-colored tempering charts explaining plain and scientific tempering in oil, water or tallow. Tells what each color will stand. Also 40 new steel working receipts, including machine and plow work, with 5 fine steel welding compound receipts, enabling you to weld all the different kinds of steel made. Also tells how to work self-hardening and the new imported French steel. All for one dollar. Send for samples free. W. M. Toy, Sidney, Ohio.

THE CHINESE LANGUAGE taught by mail. Write for particulars to David D. Jones, Official Chinese Interpreter of the United States Courts, San Francisco, California.

EAR CORN wanted; 150 cars delivered about Nov. 1st at Holland, Texas, on M. K. & T. R. R. Who will submit prices? W. L. Crosthwaite, M. D., Holland, Texas.

WANTED TO EXCHANGE—One of my standard size Steam Calliopes for a durable and powerful automobile. I desire same for advertising purposes. Address giving full particulars. George Kratz, Calliope Builder, Evansville, Ind.